# pysimavr Documentation

## *Release 0.0.5*

**ponty**

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**pysimavr**

**Date** November 13, 2011

**PDF** pysimavr.pdf

Contents:

pysimavr is a python wrapper for simavr which is AVR and arduino simulator

**Links:**

- home: https://github.com/ponty/pysimavr
- documentation: http://ponty.github.com/pysimavr

**Features:**

- python wrapper using swig
- simavr source code is included for easier installation
- object oriented interface on top of the generated interface
- maximum speed can be real-time
- serial communication
- check simavr documentation

**Known problems:**

- included simavr source code is not up to date
- Python 3 is not supported
- tested only on linux
- more tests needed
- PWM simulation is not real-time
- missing PWM modes
- a lot of messages on stdout
- LCD simulator is not fully implemented

**Possible usage:**

- unit test
- simulator

**Similar projects:**

- simavr
- emulino
- Arduino Unit
- arduemu

CHAPTER

ONE

# BASIC USAGE

```
>>> from pysimavr.avr import Avr
>>> avr=Avr(mcu='atmega48',f_cpu=8000000)
>>> firmware = Firmware('lcd.elf')
>>> avr.load_firmware(firmware)

>>> from pysimavr.sim import ArduinoSim
>>> print ArduinoSim(snippet='Serial.print("hello!");').get_serial()
hello!
```

CHAPTER

TWO

# INSTALLATION

check simavr doc: http://gitorious.org/simavr/pages/GetStarted

**ignore these in simavr doc:**

- OpenGl (freeglut)
- gcc-avr
- avr-libc
- make

## 2.1 General

- install python
- install setuptools
- install swig (for source build only)
- install header files and a static library for Python (for source build only)
- install a compiler (for source build only)
- install elf library
- install the program:

  ```
  # as root
  easy_install pysimavr
  ```

## 2.2 Ubuntu

```
sudo apt-get install python-setuptools
sudo apt-get install swig
sudo apt-get install python-dev
sudo apt-get install gcc
sudo apt-get install libelf-dev
sudo easy_install pysimavr
```

## 2.3 Uninstall

first install pip:

```
# as root
pip uninstall pysimavr
```

## CHAPTER THREE

# USAGE

pysimavr.examples.simple:

```
from pysimavr.avr import Avr

avr=Avr(mcu=’atmega48’,f_cpu=8000000)
avr.step(1)
print avr.pc
```

```
$ python -m pysimavr.examples.simple
Starting atmega48 - flashend 0fff ramend 02ff e2end 00ff
atmega48 init
2
```

pysimavr.examples.hello:

```
from pysimavr.sim import ArduinoSim
from entrypoint2 import entrypoint

@entrypoint
def run_sim():
    print ArduinoSim(snippet=’Serial.print("hello!");’).get_serial()
```

```
$ python -m pysimavr.examples.hello
Loaded 2148 .text
Loaded 26 .data
Starting atmega328 - flashend 7fff ramend 08ff e2end 03ff
atmega328 init
uart_udp_init bridge on port 4321
avr_timer_reconfigure-0 clock turned off
avr_timer_reconfigure-0 clock turned off
avr_timer_configure-0 TOP 7812.50Hz = 2048 cycles
avr_timer_configure-0 C 8888.89Hz = 1800 cycles
avr_timer_configure-0 TOP 976.56Hz = 16384 cycles
avr_timer_configure-0 C 1111.11Hz = 14400 cycles
avr_timer_configure-1 TOP 30.52Hz = 524288 cycles
avr_timer_configure-1 C 8888.89Hz = 1800 cycles
avr_timer_configure-1 TOP 3.81Hz = 4194304 cycles
avr_timer_configure-1 C 1111.11Hz = 14400 cycles
avr_timer_reconfigure-1 unsupported timer mode wgm=1 (0)
avr_timer_configure-2 TOP 976.56Hz = 16384 cycles
avr_timer_configure-2 C 1111.11Hz = 14400 cycles
avr_timer_reconfigure-2 unsupported timer mode wgm=1 (0)
ADC Start AREF 0 AVCC 5000
UART-0 configured to 00cf = 4807 bps, 5 data 1 stop
```

```
Roughly 1666 usec per bytes
hello!
```

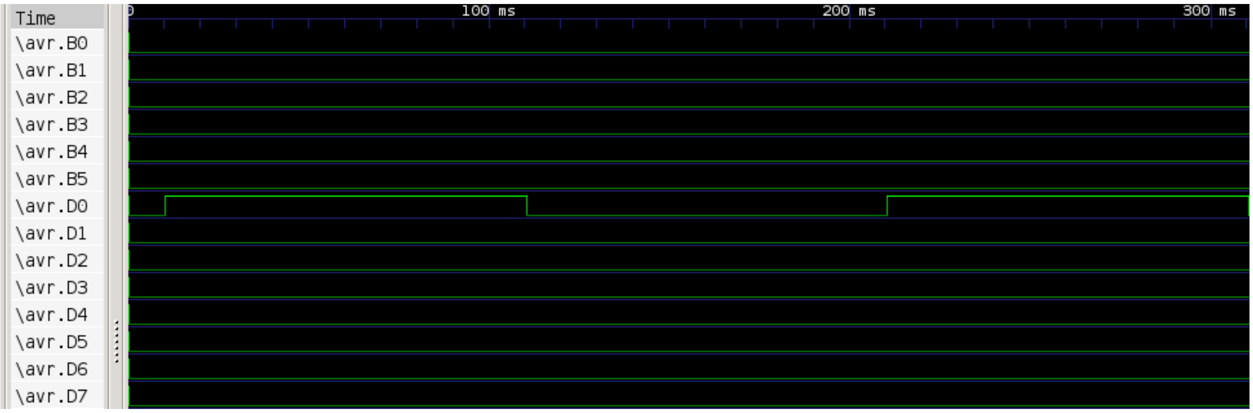
## 3.1 vcd export example

pysimavr.examples.vcd:

```
from entrypoint2 import entrypoint
from pysimavr.sim import ArduinoSim

@entrypoint
def run_sim(vcdfile='delay.vcd'):
    snippet='''
        Serial.println("start");
        pinMode(0, OUTPUT);
        digitalWrite(0, HIGH);
        delay(100);
        digitalWrite(0, LOW);
        delay(100);
        digitalWrite(0, HIGH);
        delay(100);
        digitalWrite(0, LOW);
        delay(100);
        Serial.println("end");
    '''
    sim=ArduinoSim(snippet=snippet, vcd=vcdfile, timespan=0.5)
    sim.run()
    print sim.serial
```

```
>>> from pysimavr.examples.vcd import run_sim
>>> run_sim(vcdfile='docs/vcd.vcd')
Loaded 2954 .text
Loaded 30 .data
Starting atmega328 - flashend 7fff ramend 08ff e2end 03ff
atmega328 init
uart_udp_init bridge on port 4321
avr_timer_reconfigure-0 clock turned off
avr_timer_reconfigure-0 clock turned off
avr_timer_configure-0 TOP 7812.50Hz = 2048 cycles
avr_timer_configure-0 C 15151.52Hz = 1055 cycles
avr_timer_configure-0 TOP 976.56Hz = 16384 cycles
avr_timer_configure-0 C 1893.94Hz = 8447 cycles
avr_timer_configure-1 TOP 30.52Hz = 524288 cycles
avr_timer_configure-1 C 15151.52Hz = 1055 cycles
avr_timer_configure-1 TOP 3.81Hz = 4194304 cycles
avr_timer_configure-1 C 1893.94Hz = 8447 cycles
avr_timer_reconfigure-1 unsupported timer mode wgm=1 (0)
avr_timer_configure-2 TOP 976.56Hz = 16384 cycles
avr_timer_configure-2 C 1893.94Hz = 8447 cycles
avr_timer_reconfigure-2 unsupported timer mode wgm=1 (0)
ADC Start AREF 0 AVCC 5000
UART-0 configured to 00cf = 4807 bps, 5 data 1 stop
Roughly 1666 usec per bytes
start
end
```



## 3.2 unit test example

pysimavr/examples/test_example.py

```
''' unit test example'''

from pysimavr.sim import ArduinoSim

def test_atmega88():
    mcu = 'atmega88'
    snippet = 'Serial.print("hi");'

    output = ArduinoSim(snippet=snippet, mcu=mcu, timespan=0.01).get_serial()
    assert output == 'hi'
```

```
$ nosetests --verbose pysimavr/examples/test_example.py
pysimavr.examples.test_example.test_atmega88 ... ok

----------------------------------------------------------------------
Ran 1 test in 2.075s

OK
Loaded 2068 .text
Loaded 22 .data
Starting atmega88 - flashend 1fff ramend 04ff e2end 01ff
atmega88 init
uart_udp_init bridge on port 4321
avr_timer_reconfigure-0 clock turned off
avr_timer_reconfigure-0 clock turned off
avr_timer_configure-0 TOP 7812.50Hz = 2048 cycles
avr_timer_configure-0 C 10638.30Hz = 1504 cycles
avr_timer_configure-0 TOP 976.56Hz = 16384 cycles
avr_timer_configure-0 C 1329.79Hz = 12032 cycles
avr_timer_configure-1 TOP 30.52Hz = 524288 cycles
avr_timer_configure-1 C 10638.30Hz = 1504 cycles
avr_timer_configure-1 TOP 3.81Hz = 4194304 cycles
avr_timer_configure-1 C 1329.79Hz = 12032 cycles
avr_timer_reconfigure-1 unsupported timer mode wgm=1 (0)
avr_timer_configure-2 TOP 976.56Hz = 16384 cycles
avr_timer_configure-2 C 1329.79Hz = 12032 cycles
avr_timer_reconfigure-2 unsupported timer mode wgm=1 (0)
ADC Start AREF 0 AVCC 5000
```

```
UART-0 configured to 00cf = 4807 bps, 5 data 1 stop
Roughtly 1666 usec per bytes
```

## CHAPTER FOUR

# FILE HIERARCHY

```
|-docs                   sphinx documentation
|---_build               generated documentation
|-pysimavr               main python package, high level classes
|---examples             examples
|---swig                 all swig files (simavr and parts)
|-----cores              copy from simavr
|-----include            copy from simavr
|-------avr              copy from avr-libc
|-----parts              some electronic parts in c
|-----sim                copy from simavr
|-tests                  unit tests
```

CHAPTER

FIVE

# HOW TO UPDATE SIMAVR SOURCES

1. download simavr sources
2. download avr-libc sources (Ubuntu folder: /usr/lib/avr/include/avr/)
3. download pysimavr sources
4. copy over files:

   ```
   $SIMAVR/include         ->   $PYSIMAVR/pysimavr/swig/include
   $SIMAVR/simavr/cores    ->   $PYSIMAVR/pysimavr/swig/cores
   $SIMAVR/simavr/sim      ->   $PYSIMAVR/pysimavr/swig/sim
   $AVR_LIBC_INCLUDE/avr   ->   $PYSIMAVR/pysimavr/swig/include/avr
   ```

5. install pysimavr:

   ```
   cd $PYSIMAVR
   easy_install .
   # or
   pip install .
   # or
   paver install
   # or
   python setup.py install
   ```

CHAPTER

SIX

# API

**There are 2 interfaces:**

- pysimavr.swig.*: low level, generated by swig
- pysimavr.*: high level classes, they can redirect function calls to low level interface. Example: Avr class (high level) has all properties and methods of avr_t class (low level) automatically.

## 6.1 low level interface

**class** `pysimavr.swig.ac_input.`**`ac_input_t`**

**`avr`**

**`irq`**

**`value`**

**class** `pysimavr.swig.hd44780.`**`hd44780_t`**

**`avr`**

**`cursor`**

**`datapins`**

**`flags`**

**`h`**

**`irq`**

**`pinstate`**

**`readpins`**

**`vram`**

**`w`**

**class** `pysimavr.swig.inverter.`**`inverter_t`**

**`avr`**

**`irq`**

**out**

class pysimavr.swig.ledrow.**ledrow_t**

**avr**

**irq**

**pinstate**

**pinstate_changed**

class pysimavr.swig.sgm7.**sgm7_t**

**avr**

**digit_count**

**digit_pin**

**digit_port**

**digit_segments**

**digit_segments_changed**

**irq**

**pinstate**

**segment_pin**

**segment_port**

class pysimavr.swig.simavr.**avr_io_t**

**avr**

**dealloc**

**ioctl**

**irq**

**irq_count**

**irq_ioctl_get**

**irq_names**

**kind**

**next**

**reset**

class pysimavr.swig.simavr.**avr_iopin_t**

**pin**

**port**

class pysimavr.swig.simavr.**avr_ioport_getirq_t**

**bit**

**irq**

class pysimavr.swig.simavr.**avr_ioport_state_t**

**ddr**

**name**

**pin**

**port**

class pysimavr.swig.simavr.**avr_ioport_t**

**io**

**name**

**pcint**

**r_ddr**

**r_pcint**

**r_pin**

**r_port**

class pysimavr.swig.simavr.**avr_irq_pool_t**

**count**

**irq**

class pysimavr.swig.simavr.**avr_irq_t**

**flags**

**hook**

**irq**

**name**

**pool**

**value**

class pysimavr.swig.simavr.**avr_kind_t**

**make**

**names**

class pysimavr.swig.simavr.**avr_symbol_t**

**addr**

**symbol**

class pysimavr.swig.simavr.**avr_t**

**aref**

**avcc**

**codeend**

**cycle**

**cycle_timer**

**cycle_timer_map**

**data**

**e2end**

**eind**

**flash**

**flashend**

**frequency**

**fuse**

**gdb**

**gdb_port**

**i_shadow**

**init**

**io**

**io_port**

**io_shared_io**

**io_shared_io_count**

**irq_pool**

**log**

**mmcu**

**next_cycle_timer**

**pc**

**pending**

**pending_wait**

**ramend**

**rampz**

**reset**

**run**

**signature**

**sleep**

**special_deinit**

**special_init**

**sreg**

**state**

**trace**

**trace_data**

**vcc**

**vcd**

**vector**

**vector_size**

**class** `pysimavr.swig.simavr.`**`avr_t_cycle_timer`**

**param**

**timer**

**when**

**class** `pysimavr.swig.simavr.`**`avr_t_io`**

**irq**

**r**

**w**

**class** `pysimavr.swig.simavr.`**`avr_t_io_r`**

**c**

**param**

**class** `pysimavr.swig.simavr.`**`avr_t_io_shared_io`**

**io**

**used**

**class** `pysimavr.swig.simavr.`**`avr_t_io_shared_io_io`**

**c**

**param**

**class** `pysimavr.swig.simavr.`**`avr_t_io_w`**

**c**

**param**

**class** `pysimavr.swig.simavr.`**`avr_trace_data_t`**

**codeline**

**old**

**old_pci**

**touched**

class pysimavr.swig.simavr.**avr_trace_data_t_old**

**pc**

**sp**

class pysimavr.swig.simavr.**avr_vcd_log_t**

**signal**

**value**

**when**

class pysimavr.swig.simavr.**avr_vcd_signal_t**

**alias**

**irq**

**name**

**size**

class pysimavr.swig.simavr.**avr_vcd_t**

**avr**

**filename**

**log**

**logindex**

**output**

**period**

**signal**

**signal_count**

**start**

class pysimavr.swig.simavr.**elf_firmware_t**

**aref**

**avcc**

**bsssize**

**codeline**

**codesize**

**command_register_addr**

**console_register_addr**

**datasize**

**eeprom**

**eesize**

**flash**

**flashbase**

**flashsize**

**frequency**

**mmcu**

**trace**

**tracecount**

**tracename**

**traceperiod**

**vcc**

class `pysimavr.swig.simavr.`**elf_firmware_t_trace**

**addr**

**mask**

**name**

## 6.2 high level interface

class `pysimavr.ac.`**Ac**(*avr*)

**getirq**(*pin*)

class `pysimavr.avr.`**Avr**(*firmware=None*, *mcu=None*, *f_cpu=None*, *avcc=5*, *vcc=5*)

**arduino_targets = ['atmega48', 'atmega88', 'atmega168', 'atmega328p']**

**avcc**

**fpeek**(*addr*)

**getirq**(*pin*)

**goto_cycle**(*n*)

**goto_time**(*tsec*)

**load_firmware**(*firmware*)

**move_time_marker**(*tsec_diff*)

**pause**()

**peek**(*addr*)

**reset**()

**run**()

**states** = ['Limbo', 'Stopped', 'Running', 'Sleeping', 'StepStepDone']

**step** (*n=1*, *sync=True*)

**terminate** ()

**time_passed** ()

**vcc**

**exception** pysimavr.avr.**UnkwownAvrError**

pysimavr.connect.**connect_irqs** (*irq_out*, *irq_in*, *bidirectional=False*)

pysimavr.connect.**connect_pins_by_rule** (*rule*, *device_map*, *vcd=None*)
rule example:

B0 –> D4 -> vcd

B1 <== D5 B2 => D6 #B3 <=> D7

**class** pysimavr.firmware.**Firmware** (*filename=None*)

**mcu**

**read** (*filename*)

**class** pysimavr.inverter.**Inverter** (*avr*)

**getirq** (*pin*)

**out** (*i*)

**class** pysimavr.lcd.**Lcd** (*avr*, *size=(20, 2)*)

**get_char** (*x*, *y*)

**getirq** (*pin*)

**pinstate** (*pin*)

**reset** ()

**class** pysimavr.ledrow.**LedRow** (*avr*, *size=8*)

**getirq** (*pin*)

**pinstate** (*i*)

**reset_dirty** (*i*)
read and reset

**class** pysimavr.sgm7.**Sgm7** (*avr*, *size=4*)

**digit_segments** (*digit_index*)

**getirq** (*pin*)

**pinindex** (*pin_name*)

**pinstate** (*pin*)

**reset_dirty** (*digit_index*)
read and reset

**class** `pysimavr.vcdfile.`**`VcdFile`**(*avr*, *filename='gtkwave_output.vcd'*, *period=10*)

> **`add_signal`**(*irq*, *name=None*, *bits=1*)
>
> **`start`**()
>
> **`stop`**()
>
> **`terminate`**()

CHAPTER

SEVEN

# DEVELOPMENT

## 7.1 Tools

1. setuptools
2. Paver
3. nose
4. ghp-import
5. pyflakes
6. pychecker
7. paved fork
8. Sphinx
9. sphinxcontrib-programscreenshot
10. sphinxcontrib-paverutils
11. `autorun` from sphinx-contrib (there is no simple method, you have to download/unpack/setup)

## 7.2 Install on ubuntu

```
sudo apt-get install python-setuptools
sudo apt-get install python-paver
sudo apt-get install python-nose
sudo easy_install ghp-import
sudo apt-get install pyflakes
sudo apt-get install pychecker
sudo easy_install https://github.com/ponty/paved/zipball/master
sudo apt-get install scrot
sudo apt-get install xvfb
sudo apt-get install xserver-xephyr
sudo apt-get install python-imaging
sudo apt-get install python-sphinx
sudo easy_install sphinxcontrib-programscreenshot
sudo easy_install sphinxcontrib-programoutput
sudo easy_install sphinxcontrib-paverutils
```

## 7.3 Tasks

Paver is used for task management, settings are saved in pavement.py. Sphinx is used to generate documentation.

print paver settings:

```
paver printoptions
```

clean generated files:

```
paver clean
```

generate documentation under *docs/_build/html*:

```
paver cog pdf html
```

upload documentation to github:

```
paver ghpages
```

run unit tests:

```
paver nose
#or
nosetests --verbose
```

check python code:

```
paver pyflakes
paver pychecker
```

generate python distribution:

```
paver sdist
```

upload python distribution to PyPI:

```
paver upload
```

# CHAPTER EIGHT

# INDICES AND TABLES

- *genindex*
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- *search*

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